Class Location and Time:  Tues., Thurs. 1:30-2:50 PM, Hamburg 2503

Professor:  
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Office Hours:  Tues. 9:30-10:30 AM or by appointment

Required Materials

The CAMEO E-Reader.  Unless otherwise noted, required readings for this course can be accessed from the CMU Library CAMEO website (cameo.library.cmu.edu).  Go to CAMEO, select “course reserves,” and then enter either my name or either of the course numbers for this course.  That will direct you to electronic copies of the required readings that can be accessed online or downloaded.  There are multiple pages of links to the readings; to access the later pages select “next” from the menu at the top.  To access the earlier pages, select “previous.”  Please be aware that the articles are in alphabetical order, not the order in which they appear in the syllabus.  This is a limitation of the software. While it may be inconvenient to look up readings in this fashion, it is a much cheaper way of giving students access to the material than a traditional course reader, which has cost well over $100 in recent years.

Course WebPage:  This course will use the Blackboard system.  As of the first day of class, all registered students should have complete access to the course web page.  Important class information, including copies of the lecture notes, will be distributed regularly via this web page.  All the information you need will be available in the "course documents" folder of the website.  Please check it often.

Course Objectives

The scientific community has concluded that human industrial activities are causing global temperatures to increase.  Emissions must be reduced to prevent dangerous levels of climate change, yet the growth aspirations of developing countries call for more energy use at a global level.  Even in the developed countries, where the political resolve to protect the environment is strong, democratic political systems are reluctant to sacrifice economic growth in order to achieve ambitious emissions reduction goals.  How can humanity reduce emissions while sustaining robust economic growth?  Coping with the environmental, economic, and political consequences of this challenge is considered by many to be the preeminent public policy problem of the 21st century.  If ever there were a topic that required an interdisciplinary approach, this is it.  Drawing upon the strong tradition of rigorous, interdisciplinary research and education at Carnegie Mellon and a broad range of expertise resident in its schools and departments, this course is designed to introduce masters students and advanced undergraduates
to the many different dimensions of the problem. In this course, we will investigate the science of climate change, the prospective economic impact of global warming, the uncertainty involved in long-run climate forecasting, and the technological alternatives available to us as we seek to mitigate the impact of expanding human industrial activity on the Earth’s climate. The heart of this course will be an in-depth analysis of the policy options available to the United States and the global community. We will investigate the economic costs of these options and the way political realities are likely to shape and constrain policy at the national and international levels. This course will also introduce students to the range of courses and research activities underway at CMU for those who want to study this issue in greater depth.

**Outcomes Measurement**
Student understanding of the technological alternatives available to us will be evaluated primarily through the graded "technology policy memo" described below. Student comprehension of the rest of the course will be assessed primarily through an in-class written exam (to be held on November 12) and a final exam (to be held during finals week in December).

**Pre-requisites**
Introductory economics required at the level of 90-710 or equivalent. This pre-requisite can be waived with the consent of the instructor, since the necessary economics and mathematics are taught within the class.

**Who should take this course**
Anyone who is interested in understanding the realities of ongoing global climate change, its economic and social impact, and the policy alternatives available to the human race at the beginning of the 21st century. The course will be open to masters students in the Heinz College and Tepper as well as upper level undergraduates from H&SS, CIT, and SCS.

**Course Structure**

The course will be divided into four sections.

**Part 1 – What on Earth is Going On?: The Science of Global Warming**
The first section of the course will present the essential scientific facts undergirding the strong consensus within the scientific community that human industrial activity is changing the Earth’s climate. Students will be introduced to the basic chemistry and physics behind global warming. This part of the course will feature a guest lecture from one of CMU’s climate change experts, Professor Peter Adams. Students will contend with the difficulties involved in climate change forecasting and the substantial uncertainty that surrounds our forecasts. Students will also be introduced to the concepts and analytical tools used to assess the economic impact of climate change. We will review how economists attempt to compare the costs and benefits of climate change policies -- a subject we will return to in greater depth in Part 3.

**Part 2 – Technology Alternatives**
This portion of the course will examine technological alternatives to current power generation, transportation, and production technologies that contribute to global warming. We will examine
various options including wind and solar technologies, nuclear power, biofuels, and carbon sequestration. In addition, we will consider recent developments in the technology of fossil fuel extraction (e.g., "fracking"), and the impact these developments may have on America's energy mix and carbon emissions. We will also examine the possibility of using technology to interfere with the Earth’s climate in ways that could slow or reverse global warming. In reviewing these alternatives, we will draw upon the research and expertise of a number of experts, including Allen Robinson, Chair of the Department of Mechanical Engineering at CMU, Ryan Kellogg of the University of Michigan, At the end of this section, students will be required to write a “technology policy memo” that evaluates these technology alternatives.

Part 3 – What Do We Do Now?
This portion of the course reviews the public policy debate concerning what steps should be taken now to deal with the global warming, even when its ultimate consequences remain unknown. We will closely examine the economic arguments for and against carbon taxes and emissions cap-and-trade regulatory systems. Students will be introduced to the economic and mathematical models on which the arguments for these policy options are based. We will discuss how such regulatory regimes might operate in practice, both nationally and internationally. We will discuss how the economic policies described in this section of the course could be harnessed to support the further development of the technological alternatives outlined in the previous section.

Part 4 – The Politics of Global Warming
Political considerations and clashing interests of different groups within society will inevitably shape and constrain the evolution of public policies to mitigate climate change, both in the United States and overseas. We will examine the imperfections and limitations of the Kyoto agreement and lessons that can be derived from this. We will examine the mistakes made in the implementation of a cap-and-trade emissions regulation regime in Western Europe and of a carbon tax in other countries, and discuss what lessons can be derived from this. We will also hear from participants in the U.S. public policy debate who are either currently in high-level policy positions in Washington or have recently left such positions. Confirmed guest speakers include William Pizer (former Deputy Assistant Secretary for Energy and the Environment at the U.S. Treasury Department) and Joe Aldy (former climate change and energy adviser to President Obama). Together with these experts, we will discuss the prospects for meaningful shifts in American policy going forward.

Requirements and Grading:

Class participation – 10%: Class discussions are an integral part of the course, and class participation will account for 10% of the total grade. To receive full credit for this portion of the grade, students must consistently demonstrate through participation in class discussions that they have completed the required readings and thought through the issues. In other words, students have to talk in class to get full credit.

Personal carbon audit – 10%. Students will be required to use an instructor-specified internet tool to estimate the greenhouse gas emissions generated by their personal lifestyle. This audit is due in early September. Details on this assignment, including the format of the report, will be
provided during the first week of class. Students may work together on these reports, but each student must submit a personal audit that reflects her/his personal lifestyle.

**Technology investment memo – 15%.** As a candidate for President, Barack Obama proposed setting up a governmental organization that would invest up to $15 billion in technologies to mitigate climate change and produce energy in a more environmentally friendly way. You are tasked with writing a 10-page memo that allocates this budget over different technologies and justifies your choices as being the socially optimal ones. You are encouraged to focus your attention on alternative technologies reviewed in class. This memo will be due in late October. Students are encouraged to work in small groups and submit a joint report.

**In-class examination - 20%.** There will be an in-class exam in early November that will account for 20% of the total grade. This exam will assess students’ mastery of the economic analytical tools and conceptual frameworks developed in Part 3 of the course. The exam will be open-book and open-note, but no collaboration will be permitted.

**Final examination – 45%.** There will be a final examination, worth 45% of the total grade, which will be given during the examination period. This exam will be a cumulative exam – all the material of the course is fair game. The exam will be open-book and open-note, but no collaboration will be permitted.